Lesson 12: Blade Design Competition

Adopted/Revised From
KidWind Project - Kid Wind MINI Turbine

Grade Level
6-12

Objectives
- Construct a mini wind turbine
- Test the turbine for electricity generating capability
- Compare different turbines with different blade designs
- Identify the factors that help turbines generate electricity

Overview
Students build a mini wind turbine, test the power output in various formats, and then build their own blade designs.

Materials (per group)
- KidWind Mini Blade Design Kit
- Tape
- Scissors
- Cardboard (optional)
- Art Supplies (optional)
- Fan (recommended)

Estimated Cost of Materials
$150 per group

Computer Required?
No

Duration
1-3 class periods

Primer References
3.2 Wind

Engagement
1. What are some different sources of energy?
2. What are wind turbines used for?
3. What are the different parts of a wind turbine?
4. Describe some different types of wind turbines and blade designs.

Investigation

Now we're going to investigate how wind energy works by building our own turbines:

1. Divide the groups up depending upon the amount of MINI turbines you have available.
2. Students can take turns building and testing the turbines, however everyone can design their own blades in a final activity.

Build the KidWind MINI Turbine base following the KidWind directions (summarized here):

1. Separate the round yellow base from the metal rod (turbine tower).
2. Run the red and black wires from the turbine tail/nacelle through the metal rod and wooden base, thereafter connecting the nacelle to the top of the rod.
3. Inserting the round yellow base up from the hole in the bottom of the wooden base, connect the yellow base to the metal rod inside the hole of the wooden base.
4. Gently push the red blades onto the nacelle. The hole on the back side of the blades will fit by friction onto the nacelle.
5. If you need to remove the blades, you can use a screwdriver to pry the blade set off the nacelle, if needed. Use caution not to break a blade.

Test the KidWind MINI Turbine (use a fan (recommended) or go outside for wind):

6. Test #1
    a. Power Output Board – test the KidWind MINI Turbine by connecting the black wires from the turbine to the black wires to the power output board using the black wire clips.
    b. Connect the red wires of the turbine to the red wires of the power output board using the red wire clips.
    c. Run the fan or place outside in the wind and turn the switch to music, flash, and/or torch.
7. Test #2
    a. Multimeter - to use the multimeter, connect the red test lead to the VOhmMA jack and the black lead to the COM jack.
    b. Connect the red wires to the red test lead and the black wires to the black test lead.
    c. Turn on the fan to the low setting and record DC voltage by turning the multimeter dial left to the 500, 200, or 20 setting (20 should work fine since low voltage is expected).
    d. Then record the amperage (in milliamps) by turning the dial right (past the OFF position) to the 200m setting (or other, but this should work fine for most applications).

Build and Test Your Own Blades

8. Students can build their own blades using the wooden dowels and corrugated plastic board provided in the KidWind kits and/or other classroom supplies as well as tape and scissors.
9. Once blades are constructed and attached to the turbine, have students fill out the Activity Sheet for this lesson using the multimeter.

Class Review

1. Ask the class to share the results of their blade design and wind speed experiments in order to identify the blade design capable of generating the most electricity.
2. Have students discuss the Activity Sheet questions as a class.

Elaboration

Now that we have seen how wind turbines work:

1. Have students read the Primer References for this lesson.
2. As a class, list or "map" the energy forms associated with the transfer of energy from its source in the wind to the light we see from the LED light bulb on the turbine.

Instructor Notes

- Students in groups can compare different blade designs at the same wind speed or can compare the same blade design at different wind speeds.
- After groups complete their activities the whole class can discuss how different blade designs compare at different wind speeds.
- Turbines should be tested at the same distance away from a fan (i.e. 2 ft.) in order to accurately compare blade designs.
- The blades may need to be manually spun (lightly) in front of the fan before the blades are able to spin from the fan-generated wind alone.

Extensions and Variations

- Join three turbines together to form a Wind Farm and measure voltage and amperage.
- Use anemometers from the "Capturing the Wind" lesson to measure the wind speed outside and experiment with different blade designs outside.
- Enter your winning students in a national Blade Design competition – learn more here: http://learn.kidwind.org/challenge/national/overview

References/For More Information

KidWind Project: www.kidwind.org

Blade Design Competition

Blade Design	Description*	# Blades	Blade Angle (relative to ground)	Blade Length	Weight (if possible)	Fan Setting/ Wind Speed (if known)	Voltage (DC)	Milliamps	Milliwatts
1									
2									
3									
4									
5									

*Compare the same blade design at different wind speeds or different blade designs at the same wind speed.

Questions

1. Graph the relationship between wattage and fan setting/wind speed:

2. Which blade design was best? Why?

3. What were the characteristics of the blade designs with the highest currents? Voltages? Why?

4. Which blade design would be the most economical to mass produce? Why?